



Investigating Children with Respiratory Allergy for Undiagnosed Rhinosinusitis

Thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قُلْ لَوْ كَانَ الْبَحْرُ مِدَادًا لِّكَلِمَاتِ
رَبِّي لَنَفِدَ الْبَحْرُ قَبْلَ أَنْ تَعْقَدَ
كَلِمَاتُ رَبِّي وَلَوْ جِئْنَا بِمِثْلِهِ مَدَدًا

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List of Contents

Title	Page
▪ List of Abbreviations	II
▪ List of Tables	V
▪ List of Figures	VII
▪ Introduction and Aim of Work	1
▪ Review of Literature	3
- Anatomy and development of sinuses	4
- Connections and aeration of the sinuses.....	8
- Rhinosinusitis in children.....	9
- United airway disease	21
- The link between respiratory allergy and sinusitis.....	22
- Diagnosis of rhinosinusitis	24
- Management of rhinosinusitis	31
▪ Patients and Methods	45
▪ Results	57
▪ Discussion	73
▪ Recommendations	85
▪ Summary	86
▪ References	89
▪ Arabic Summary	--

List of Abbreviations

ABPA	Allergic bronchopulmonary Aspergillosis
ABRS	Acute bacterial rhinosinusitis
AECS	Acute exacerbation of chronic Sinusitis
AFRS	Allergic fungal rhinosinusitis
AIFRS	Acute invasive fungal rhinosinusitis
APCS	Antigen Presenting Cells
AR	Allergic Rhinitis
ARS	Acute rhinosinusitis
CBC	Complete Blood Count
CBCT	Cone-beam computed tomography
CF	Cystic Fibrosis
CHES	Chronic Hyperplastic Eosinophilic Sinusitis
CRP	C-Reactive protein
CRS	Chronic Rhinosinusitis
CRSsNP	Chronic Rhinosinusitis without Nasal Polyps
CRSwNP	Chronic Rhino Sinusitis with Nasal Polyps
CT	Computed Tomography
DMRT1	Double sex and mab-3 related transcription factor 1

List of Abbreviations

EAACI	European Academy of Allergy and Clinical Immunology
EIA	Enzyme Immno assay
EPOS	European position paper on rhinosinusitis and nasal polyps guidelines
ESR	Erythrocyte sedimentation rate
FESS	Functional endoscopic sinus surgery
FEV	Forced expiratory volume
GE	General Electric
GER	Gastro esophygeal reflux
IDSA	Infectious diseases society of America
IgE	Immunoglobulin E
IL-5	Interleukin 5
ILC	Innate Lymphoid Cells
INA	intranasal inferior meatal antrostomy
INCs	Intranasal corticosteroid
ISAAC	International study of asthma and allergy in childhood
IT	Immunotherapy
LTRAs	Leukotriene receptor antagonists
MAST	Multipe Allergen Simultaneous Tests
MF	Mometasone Furoate
MHC	Major histocompatability complex

List of Abbreviations

MRI	Magnetic Resonance Imaging
NPs	Nasal Polyps
OCS	Oral corticosteroids
OMC	Osteo- meatal complex
PEF	Peak expiratory flow
RARS	Recurrent acute rhinosinusitis
RAST	Radio Allergo Sorbent Test
RP	Rhinopharynx
RS	Rhinosinusitis
SER	Spheno-ethmoidal recess
SLIT	Sublingual immuno-therapy
SLIT	Sublingual immune-therapy
SNI	Saline Nasal Irrigation
SPT	Skin Prick Test
URT	Upper Respiratory Tract

List of Tables

Table No.	Title	Page
Table (1):	Classification of sinusitis.....	13
Table (2):	Oral antihistamines in pediatrics.....	43
Table (3):	Intranasal H1-antihistamines in pediatrics	43
Table (4):	Intranasal corticosteroids in pediatrics	44
Table (5):	Levels of asthma control.....	47
Table (6):	Assessments of asthma severity.....	48
Table (7):	Estimated equipotent daily doses of inhaled glucocorticosteroid for adults and children older than 5 yrs	49
Table (8):	Low daily doses of inhaled glucocorticosteroid for children younger than 5 years.....	49
Table (9):	Total serum IgE related reference ranges	55
Table (10):	Clinical and demographic data of enrolled patients	57
Table (11):	Bronchial asthma among enrolled patients with allergic rhinitis	59
Table (12):	Anti-allergic medications use among enrolled patients	60
Table (13):	Skin prick test results among enrolled patients	61
Table (14):	Results of laboratory work-up of enrolled patients	62
Table (15):	Paranasal CT scan findings among enrolled patients	63

Table No.	Title	Page
Table (16):	Frequency of sinus affection in children with radiological findings of sinusitis	63
Table (17):	Raw radiologic and rhinoscopic findings in studied sample	64
Table (18):	Comparison between patients with and without radiological findings suggestive of sinusitis.....	68
Table (19):	Variation of clinical manifestations of allergic rhinitis in patients with and without nasal sinusitis	69
Table (20):	Variation of pattern of bronchial asthma in patients with and without radiological findings suggestive of sinusitis.....	69
Table (21):	Anti-allergic medications requirement in patients with and without radiological findings suggestive of sinusitis	70
Table (22):	Comparison of laboratory work-up in patients with and without radiological findings suggestive of sinusitis	70
Table (23):	Variation of nasal endoscopic and other CT scan findings in the studied sample.....	71
Table (24):	Comparison of skin prick test for common environmental allergens in patients with and without radiological findings suggestive of sinusitis	72

List of Figures

Figure No	Title	Page
Fig. (1):	Paranasal sinuses overview	7
Fig. (2):	Anatomy of the ethmoid and maxillary sinuses	7
Fig (3):	Algorithm for management of ARS in children and adults	35
Fig (4):	Allergic rhinitis management algorithm	42
Fig.(5):	Clinical manifestations of allergic rhinitis/rhinosinusitis among enrolled patients.	58
Fig. (6):	Degree of asthma severity among enrolled patients	59
Fig. (7):	Skin prick test results among enrolled patients	61
Fig. (8):	CT scan showing coronal cuts of paranasal sinuses of patient with suspected AFS	67

Introduction

Paranasal sinuses are empty spaces located within the skull bones around the nasal cavity (*Korkmaz and Korkmaz, 2013*). The paranasal sinuses, along with the turbinates, facilitate the function of the nasal space in the warming and humidification of air and contribute to the body's defences against microbial ingress (*Bell et al., 2011*).

Rhinitis and sinusitis are among the most common medical conditions and are frequently associated. Both rhinitis and sinusitis can significantly decrease quality of life, aggravate comorbid conditions, and require significant direct medical expenditures. Both conditions also create even greater indirect costs to society by causing lost school days and reduced learning capacity (*Passali et al., 2015*).

Rhinosinusitis (RS) clinical diagnosis in children is challenging, due to the overlapping of symptoms with other ordinary childhood nasal diseases, such as viral upper respiratory tract infections and allergic rhinitis (*Fokkens et al., 2012*). Allergic rhinitis is the most common type of chronic rhinitis, affecting 10 to 20% of the population. Severe allergic rhinitis is associated with significant impairments in quality of life, sleep and school performance (*Dykewicz and Hamilos, 2010*).

The link between asthma, allergic rhinitis and rhinosinusitis is well known and internationally accepted, while the precise concept of a united airways disease has been postulated (*Passalacqua et al., 2001*). The therapeutic approach should focus not only on the control of the united airways disease to avoid respiratory complications, but also to provide a better quality of life in patients and to let them be comparable to the general population in everyday settings (*Caimmi et al., 2012*).

Aim of the Work

This study is aimed to investigate a group of atopic children with physician-diagnosed allergic rhinitis for the presence of documented sinusitis. The ultimate objective is to provide adequate therapy and reduce morbidity.

Review of Literature

Paranasal sinuses are air-filled hollows in the skull bones connected to the nose. They humidify, filter, warm, and sense what we breathe. Their anatomy and physiology interact forming a dynamic system (*Jones, 2001*).

The **major paranasal sinuses** are: *Maxillary sinus*- one sinus located within the bone of each cheek. *Ethmoid sinus*- located under the bone of the inside corner of each eye, although this is often shown as a single sinus, this is really a honeycomb-like structure of 6-12 small sinuses. *Frontal*- one sinus per side, located within the bone of the forehead above the level of the eyes and nasal bridge. *Sphenoid*- one sinus per side, located behind the ethmoid sinuses; the sphenoid is not seen in a head-on view but is better appreciated looking at a side view (figure1) (*Chandra and Patel, 2015*).

Typically the ethmoidal and maxillary sinuses are present at birth, but only the ethmoidal sinuses are pneumatized. The maxillary sinuses are not pneumatized until 4 year of age. The sphenoidal sinuses are present by 5 year of age, whereas the frontal sinuses begin development at age 7-8 year and are not completely developed until adolescence (*Pappas et al., 2016*)

Anatomy and development of the sinuses

The **maxillary sinus** resembles a four-sided pyramid. The base lies vertically on the medial surface and forms the lateral nasal wall. The apex extends laterally into the zygomatic process of the maxilla. The roof of the sinus is also the floor of the orbit. The posterior wall extends the length of the maxilla **(figure 2)** (*Ahmed, 2013*).

Developmentally, it is the first sinus to develop and is filled with fluid at birth. It grows according to a biphasic pattern, in which the first phase occurs during years 0-3 and the second during years 6-12 (*Dalgorf and Harvey, 2013*) ; *figure 1*.

The frontal sinus is housed in the frontal bone superior to the eyes in the forehead. It is formed by the upward movement of anterior ethmoid cells after the age of 2 years. The frontal sinuses are funnel-shaped structures with their ostia located in the most dependent portion of the cavities. The posterior wall of the frontal sinus, which separates the sinus from the anterior cranial fossa, is much thinner than its anterior wall (*Wormald, 2005*). Developmentally, this is the last sinus to pneumatize. The frontal sinus is formed by pneumatization of the frontal recess into the frontal bone. Growth increases at age 6 years and continues until the late teenage years. The frontal sinuses are funnel-shaped structures with their ostia located in the most dependent portion of the cavities (*Ahmed, 2013*).

Frontal and/or maxillary sinusitis frequently originates with pathologic processes of the ethmoid sinuses. This clinical association is explained by the close anatomical relationship between the frontal and maxillary sinuses and the ethmoid sinus, since developmental trajectories place the ethmoid in a strategic central position within the nasal complex (*Márquez et al., 2008*).

The ethmoid sinuses arise in the ethmoid bone, forming several distinct air cells between the eyes. They are a collection of fluid-filled cells at birth that grow and pneumatize until the age of 12 years. The ethmoid cells are shaped like pyramids and are divided by thin septa. They are bordered by the middle turbinate medially and the medial orbital wall laterally. The ethmoid labyrinth may extend above the orbit, lateral and superior to the sphenoid, above the frontal sinus, and into the roof of the maxillary sinus (*Scuderi et al., 1993*). In some situations, the ethmoid cells might pneumatize into the head of the middle turbinate (a variation known as concha bullosa) and extreme middle turbinate aeration; greatly enlarging the turbinate might narrow the ostiomeatal complex enough to predispose toward rhinosinusitis. The location of the anterior ethmoid sinuses and middle meatus makes the ostiomeatal complex particularly at risk from environmental exposures, and this region is typically the first and the most frequently involved region in chronic rhinosinusitis (*Yousem et al., 1991*).